CEC®

TRANSMITTAL LETTER

June 2, 2022

City of Norman

RE: Griffin Park – Report No. CEC-22-09 CEC No. 12130

CEC Corporation appreciated the opportunity to provide geotechnical engineering services for the project located in Norman, Oklahoma. We have included the geotechnical report which includes the results of the field exploration and recommendations. If there have any additional questions, feel free to contact me at beth.ryon@connectcec.com or 918-323-5583. We enjoyed working with on this project and look forward to continuing to provide services for future projects utilizing our in-house services and trusted partners.

Sincerely,

Beth Ryon, P.E.
CEI Testing Department Manager

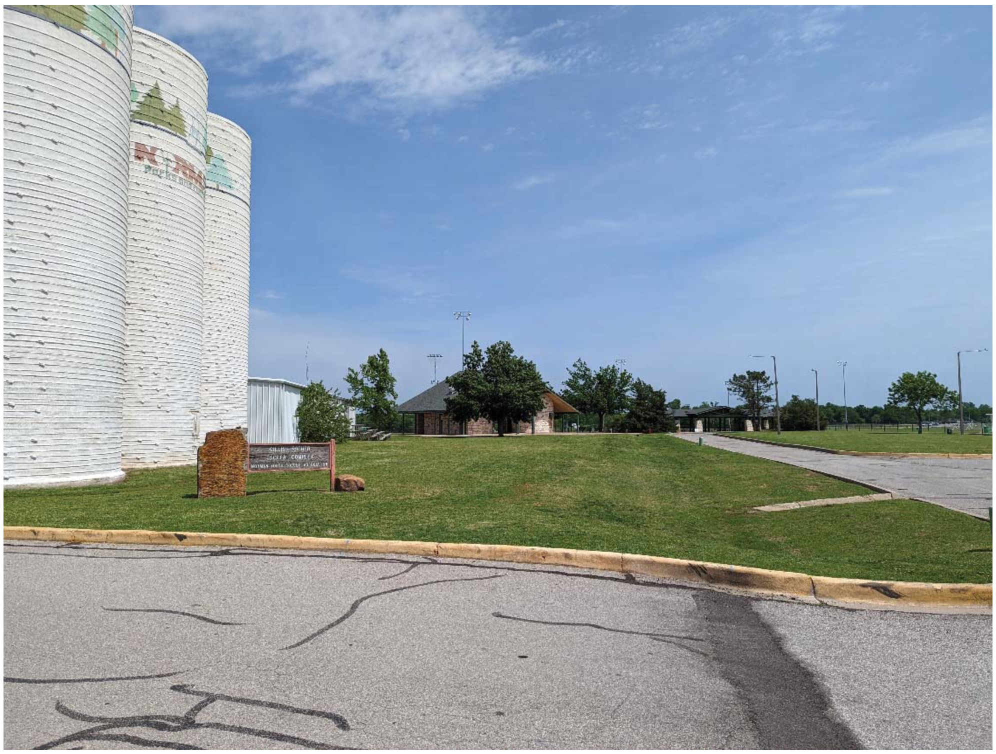
Enclosure: Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT

GRIFFIN PARK

E ROBINSON STREET & 12th AVENUE NE
NORMAN, OKLAHOMA

HGE PROJECT NO. CEC-22-09



PREPARED FOR:

CEC CORPORATION
OKLAHOMA CITY

REPORT DATE:

JUNE 2, 2022

HINDERLITER
GEOTECHNICAL ENGINEERING

June 2, 2022

CEC // Infrastructure Solutions
4555 W. Memorial Road
Oklahoma City, OK 73142-2013

Attn: Ms. Beth Ryon, P.E.

Re: Geotechnical Engineering Report
Griffin Park
Norman, Oklahoma
HGE Project No. CEC-22-09

Dear Ms. Ryon:

The Geotechnical Engineering Report has been completed for the proposed improvements to Griffin Park in Norman, Oklahoma. Our services and fees were detailed in email correspondence dated April 25, 2022. Acceptance of the scope, fee and notice to proceed were provided by issuance of CEC Task Order No. 150, dated April 28, 2022.

The purpose of the attached report is to provide a summary of the field investigation methods used and provide recommendations concerning earthwork and the design and construction of on-grade slabs and foundations. Test results are provided in the appendices of this report.

Ms. Ryon, please do not hesitate to contact HGE at (405) 942-4090 should you have questions regarding this report.

Respectfully:
HINDERLITER GEOTECHNICAL ENGINEERING, LLC
Certificate of Authorization No. 5528, Expires 30-June-2023

LICENSED PROFESSIONAL ENGINEER
MARK
H.
HINDERLITER
6-2-2022
21327
OKLAHOMA

Mark H. Hinderliter, P.E.
Oklahoma No. 21327

P:\HGE\Reports\2022 Geo\June\CEC-22-09 Report

Copies: beth.ryon@connectcec.com (pdf report & invoice)

4071 NW 3RD STREET ▪ OKLAHOMA CITY, OKLAHOMA 73107 ▪ OFFICE 405.942.4090 ▪ WWW.HINDERLITERGEO.COM
PROUDLY SERVING OKLAHOMA & TEXAS

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1.0 EXECUTIVE SUMMARY

The subsurface exploration and laboratory soil testing are complete for the improvements to Griffin Park in Norman, Oklahoma. We understand three small foot-print, single-story buildings will be constructed. Associated parking and drive areas included in the development are expected to be a mixture of light-duty and heavy-duty pavements and may be either Portland cement or asphaltic cement concrete. Building footprint areas, construction type and foundation loads were unknown at the time of this report.

Exploration of the subsurface materials at the project site consisted of advancing three soil test borings to depths of 15 feet within the building footprint areas and eight borings advanced to depths of 5 feet within the parking and drive areas. The approximate location of each boring is recorded in the lower right corner of the boring logs and is displayed on the boring location diagram, both included within Appendix A of this report.

The borings were located on grass fields or dozer cleared fields. The subsurface soils consisted of varying shades of brown and red, medium stiff to very hard, lean clay and lean to fat clay soils. Hard, geologic materials were tagged at the base of borings B-7 and B-10. These materials were not penetrated a sufficient depth to determine consistency but appear to be weathered shale or weathered sandstone of the Hennessey Unit (Phy).

The borings were monitored for the presence of groundwater while drilling and immediately after boring completion. Groundwater was encountered within boring B-1 at a depth of approximately 7 feet while sampling and was measured at 12 feet after boring completion. Groundwater was not encountered within the remaining borings at these times. The borings were backfilled or plugged per OWRB requirements after final groundwater levels were obtained.

Based on the subsurface conditions encountered at the time of our investigation, the buildings can be supported on post tension slab foundations. Shallow footing foundations used in conjunction with on-grade floor slabs can also be considered. Pavements can be supported on a thickness of crushed aggregate base; subgrade stabilization using calcium-based admixtures may also be considered.

2.0 PROJECT DESCRIPTION

Griffin Park located northwest of the intersection of E Robinson Street and 12th Avenue NE in Norman, Oklahoma. We understand three small foot-print, single-story buildings will be constructed. Associated parking and drive areas included in the development are expected to be a mixture of light-duty and heavy-duty pavements and may be either Portland cement or asphaltic cement concrete. Building footprint areas, construction type and foundation loads were unknown at the time of this report.

3.0 SITE EXPLORATION

3.1 Boring Layout & Elevations

Eleven soil test borings were advanced to depths of 5 feet to 15 feet across the site. The approximate locations of the borings are recorded in the lower right corner of the boring logs and are displayed on the boring location diagram, both included in Appendix A of this report. Boring locations were estimated based on site plan provided to us; final boring coordinates were determined in the field using a smart phone.

Elevations at the boring locations were determined using a common surveyor's level and grade road. A stake marked BM# 407, located in the center median of the entrance drive off Robinson, was used to determine ground surface elevations at the boring locations. The benchmark was assigned a relative elevation of 100 feet. Based on this benchmark, elevations at the boring locations ranged from 100.2 feet to 109.0 feet.

Boring locations and elevations should be considered only roughly accurate and not survey quality. Borings are often offset in the field by drill operators to locations accessible to the drill rig or to avoid utilities. Significant offsets are typically noted on the boring logs.

3.2 Subsurface Investigation

A truck-mounted, CME-45 drill rig outfitted with 6-inch solid augers was used to advance the boreholes. Representative soil samples were obtained using the split-barrel sampling procedure as detailed in ASTM D 1586. One bulk composite soil sample was obtained from the augers.

ASTM D 1586 is commonly referred to as the Standard Penetration Test (SPT). The split-barrel sampling process requires a two-piece sampling tube be used to obtain soil samples. A two-inch outside diameter sampling tube is hammered into the bottom of the boring with a 140-pound weight falling 30 inches. The number of blows required to advance the sampling tube the last 12 inches, or less, of an 18-inch sampling interval is recorded as the SPT resistance value, N. The in-situ relative density of granular soils, consistency of cohesive soils, and the hardness of weathered bedrock can be estimated from the N value. The N values recorded for each test are displayed on the attached boring logs adjacent to their relative sampling depths.

An automatic drive hammer was used to advance the split-barrel sampler. A greater mechanical efficiency is achieved using an automatic drive hammer when compared to a conventional safety drive hammer operated with a cathead and rope. The effect of this higher efficiency on the N values has been considered in our interpretation and analysis of the subsurface information provided with this report.

The drill crew prepared field boring logs as part of the subsurface exploration operations. The split-barrel samples were packaged in plastic bags to reduce moisture loss, labeled for identification and transported to our laboratory for further evaluation. Appendix A of this report contains the final boring logs that represent modifications based on the engineer’s observations.

The borings were backfilled or plugged per OWRB requirements after final groundwater measurements were obtained. Groundwater level measurements are included in Section 5.3 of this report.

4.0 LABORATORY EVALUATION

As part of the geotechnical investigation, soil samples obtained from the borings were evaluated for in-situ moisture content. A geotechnical engineer selected representative samples for further laboratory analysis. These tests were chosen to help the engineer classify the soils and to provide their engineering properties. These laboratory tests include Liquid and Plastic Limits (commonly referred to as Atterberg Limits) and Washed Sieve Analysis. The moisture-density relationship, soluble sulfate content and bearing ratio of the bulk sample was evaluated. The engineer reviewed all soil descriptions and made modifications based on the materials plasticity, texture, and color along with the laboratory test results.

The laboratory test results and an estimated group symbol from the Unified Soil Classification System are provided next to their representative sample locations in the appropriate column of the boring logs. The following sections provide brief information about some of the tests performed.

4.1 In-Situ Moisture Content

The in-situ moisture content of soil samples was determined in the laboratory in general accordance with specification ASTM D 2216. The results of these tests have been provided in the appropriate column of the boring logs. The moisture content is expressed as a percentage and is the ratio of the weight of water in a given amount of soil to the weight of solid particles.

4.2 Liquid & Plastic Limits

The Liquid Limit (LL) and Plastic Limit (PL) of selected soil samples were determined in the laboratory in general accordance with ASTM D 4318. The results of these tests have been provided in the appropriate column of the boring logs. The Liquid Limit (LL) of a soil is the water content at which the soil passes from a liquid state to a plastic state. The Plastic Limit (PL) of a soil is the water content at which the soil passes from a plastic state to a semi-solid state. The Plasticity Index (PI) is the difference between the Liquid Limit and the Plastic Limit (PI = LL – PL). There is a correlation between these limits and experimental shrink / swell data.

4.3 Sieve Analysis Test

The amount of material passing the No. 4, No. 10, No. 40 and No. 200 U.S. Standard Sieves was determined in the laboratory in general accordance with ASTM D 1140. Determination of the material grading, combined with the LL, PL and PI provide the information needed to classify the soil according to the Unified Soil Classification System (USCS). The resultant percentage of material passing each sieve has been provided in the appropriate column of the boring logs.

4.4 Moisture-Density Relationship of Soils

The moisture-density relationship of the bulk composite soil sample obtained from the borings was determined in general accordance with ASTM D 698 (commonly referred to as the standard-effort Proctor test). Results of this test are included in Appendix B of this report. The maximum dry density and optimum moisture content of the sampled materials are determined from this test. These values are used to determine the target molding properties of CBR specimens. The maximum dry density and optimum moisture are determined by constructing a curve from a plot of density vs. moisture.

4.5 Bearing Ratio (CBR)

The Bearing Ratio strength was determined in general accordance with ASTM D 1883. Once the standard-effort maximum dry density and optimum moisture content are determined, specimens are compacted within CBR molds at varying degrees of compactive effort. A surcharge weight equivalent to the estimated weight of pavement and base is placed on the sample and the entire assembly is immersed in water for four days. While soaking, the swell of each specimen is measured. At the completion of the soaking period, the samples are removed from the water and allowed to drain. The sample, with the surcharge imposed, is subjected to penetration by a 1.95-inch diameter piston moving at a speed of 0.05 in/min. A plot of the load versus penetration curve is constructed. The unit load corresponding to 0.1-inch penetration is recorded as the CBR value. The design CBR value is the value corresponding to 95 percent compaction of the specimen's maximum dry density.

4.6 Total Soluble Sulfates

The total soluble sulfate content of selected subgrade soil samples was determined in general accordance with test method OHD L-49. The results are used to determine whether chemical stabilization of the tested soil is appropriate.

5.0 FINDINGS & RECOMMENDATIONS

Based on the subsurface conditions encountered at the time of our investigation, the buildings can be supported on post tension slab foundations. Shallow footing foundations used in conjunction with on-grade floor slabs can also be considered. Pavements can be supported on a thickness of crushed aggregate base; subgrade stabilization using calcium-based admixtures may also be considered.

5.1 Site Conditions

Griffin Park is located northwest of the intersection of E Robinson Street and 12th Avenue NE in Norman, Oklahoma. The site features a variety of athletic competition fields. The eastern portion of the site was largely dozer cleared and construction activities were underway at the time of our investigation. The site appeared relatively flat to gently rolling. Adjacent properties appeared to be a mix of municipal and residential.

5.2 Subsurface Conditions

The borings were located on grass fields or dozer cleared fields. The subsurface soils consisted of varying shades of brown and red, medium stiff to very hard, lean clay and lean to fat clay soils. AASHTO classifications of the soils were predominantly A-6 and A-7-6 with A-4 soils encountered at one location. Hard, geologic materials were tagged at the base of borings B-7 and B-10. These materials were not penetrated a sufficient depth to determine consistency but appear to be weathered shale or weathered sandstone of the Hennessey Unit (Phy).

Based on Table 20.3-1, Site Classification, from ASCE 7-10 and the SPT "N" values recorded from the borings to depths of 15 feet, a seismic site class C should be used for building design.

A graphic log of each boring is included in Appendix A of this report. Every attempt is made to accurately reflect the depths of material change; however, stratification boundaries should be considered approximate.

5.3 Groundwater Conditions

The borings were monitored for the presence of groundwater while drilling and immediately after boring completion. Groundwater was encountered within boring B-1 at a depth of approximately 7 feet while sampling and was measured at 12 feet after boring completion. Groundwater was not encountered within the remaining borings at these times. The borings were backfilled or plugged per OWRB requirements after final groundwater levels were obtained.

To obtain more accurate groundwater level information, long-term observations in a well or piezometer that is sealed from the influence of surface water would be needed. Groundwater level fluctuations and / or perched water conditions may occur due to seasonal variations in the amount of rainfall and other factors such as drainage characteristics. The possibility of groundwater level fluctuations should be considered during the preparation of construction plans.

5.4 General Site Development

Site preparation for the proposed buildings and pavements should include removing all existing vegetation and topsoil to a depth of at least 8 inches. Any previously placed fill materials should also be removed. Any roots larger than 1-inch in diameter, rocks larger than 3 inches in diameter, and any matted roots should be removed from the proposed construction area. Any other unsuitable materials encountered during construction operations should be removed.

After removing the recommended deleterious materials and making any required cuts, but before placing fill or concrete, the site should be proof-rolled to identify any soft or loose areas. Proof-rolling operations should be observed by qualified geotechnical personnel to identify soft or loose areas to be removed or stabilized, and to verify that all unsuitable materials have been removed. Proof-rolling should be performed using a loaded, tandem-axle dump truck having a minimum gross weight of 25 tons, or other equipment having a similar subgrade loading. Proof-rolling should be performed slowly and in overlapping passes, repeating the process in a perpendicular direction. Any areas of rutting or pumping should be removed and replaced with moisture-conditioned, low volume change soil (defined in section 5.6 of this report).

The soils encountered on site are susceptible to becoming soft or loose with the addition of moisture. During periods of rain, the site may become unworkable and difficult to travel across. If wet subgrade conditions are encountered during construction, we recommend reducing the soil's moisture content by aeration. Drying the subgrade soils using calcium-based admixtures could also be considered.

5.5 Post-Tensioned Slab Foundations

The soils encountered across the site were low plasticity to moderately plastic clay soils for which significant shrinking or swelling due to moisture variations within the soils could occur. Therefore, post-tension slab foundations can be used to support the proposed buildings. Post-tension slab foundations are generally capable of tolerating more differential movement than the conventional slab and footing design. A post-tensioned slab supported within undisturbed, native soils or tested and approved fill can be designed using a maximum net allowable bearing pressure of 2,000 psf. Post-tension slab foundations should be designed to tolerate differential movements of up to 1-1/2 inches. The net allowable bearing pressure refers to the pressure at the foundation level in excess of the surrounding overburden pressure. We recommend perimeter grade beams or turned-down edges of the post-tensioned slab extend a minimum of 2 feet below final exterior grade to provide protection against frost heave and lessen the effects of moisture variations within the soils.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry material, or any loose or disturbed material in the bottom of the footing excavations, should be removed prior to placing concrete.

5.6 On-Grade Slab Subgrade

One factor affecting on-grade slab support is the shrink-swell potential of the subgrade materials due to seasonal variations in the subgrade moisture content. Typically, some increase in moisture content will occur as a result of gradual accumulation of capillary moisture after a slab is constructed. The shrink-swell potential of the soil beneath an on-grade slab is dependent on its plasticity, moisture content, density, confining pressure provided by the weight of the slab and the overburden pressure (including the fill required to develop design grade). Higher plasticity and density and lower confining pressure and moisture content result in greater swell potential of the soils.

The existing near surface soils at the boring locations consist of low plasticity to moderately plastic clay soils for which significant volume changes due to variations in subgrade moisture content could occur. Typically, buildings such as those proposed for this site are designed to tolerate vertical floor slab movements of approximately 1-inch or less. Based on the soils liquid limit, plastic limit and an expected moisture change zone of about 8 feet, we predict a potential vertical rise (PVR) between 1-inch and 1-1/2 inches could occur. Therefore, the existing subgrade soils are considered to be unsuitable for direct support of floor slabs. We recommend constructing a low volume change soil support zone at least 18 inches in thickness. The following recommendations are provided to develop this low volume change soil zone beneath the slab.

After over-excavating a minimum of 18 inches, but before placing any fill, the exposed subgrade should be scarified to a minimum depth of 8 inches and compacted to at least 95 percent of its maximum dry density as determined by test method ASTM D 698 (commonly referred to as the standard Proctor) at a moisture content of optimum or above. Any soft or loose areas observed, or over-saturated, rutting or pumping soils observed during the compaction operation should be removed and replaced with moisture-controlled, low volume change soils.

All fill required to develop the 18-inch soil support zone should consist of suitable low volume change (LVC) fill materials. The LVC pad should extend laterally at least one foot outside the slab footprint for every foot of fill placed. Suitable LVC soils are considered to be lean, cohesive materials with a liquid limit less than 40 and a plasticity index between 5 and 18, or cohesion-less materials with at least 25 percent passing the standard No. 200 sieve. Crushed aggregate materials can also be considered LVC material. All fill should be placed in lifts not exceeding 9 inches in loose thickness and compacted to at least 95 percent of the material's maximum dry density. Fill soils should be placed at a moisture content within two percent of optimum (test method ASTM D 698).

During compaction operations, the exposed subgrade and each lift of compacted fill should be tested for moisture and density and reworked as necessary until the lift is approved by the geotechnical engineer's representative prior to the placement of additional material. We recommend the scarified surface and each lift of fill be tested for density and moisture content at a rate of one test per 2,500 square feet of compacted area with a minimum of two tests per compacted area. In addition, we recommend one test per lift for every 100 linear feet of compacted utility trench backfill.

The ground surface should be sloped away from on-grade slabs on all sides to prevent water collection. Water should not be allowed to pond near the slab during or after construction. The moisture content of the soil pad should be maintained near optimum until the slab is constructed. We recommend the moisture content of the on-grade slab subgrade be evaluated just before concrete for the slab is placed.

If floor slabs will be covered with materials that are impervious to moisture migration, we recommend taking precautions to minimize the potential for floor covering problems relative to moisture emission. These precautions should include the following: Place a heavy-duty vapor retarder immediately below the floor slabs and seal the retarder at all penetration points. All fill materials should be placed *below* the vapor retarder. Concrete for the floor slabs should have a low slump and should be carefully cured due to the retention of mix water at the base of the slab over the vapor retarder. To maximize effectiveness, floor slab concrete should be water-cured for at least 7 days, which will also reduce the potential for slab edge curling. Lastly, after the building is enclosed and the HVAC is operating, slab moisture emission tests should be performed to confirm that vapor emission levels comply with the floor covering manufacturer's specifications.

SUMMARY OF EARTHWORK FOR ON-GRADE SLABS	
Clear & Grub	Remove all vegetation and topsoil to a depth of 8 inches and all existing fill
Over-Excavate	18 inches
Proofroll	Exposed soils at base of over-excavation
Scarify & Recompact	Top 8", compact to 95% MDD at moisture of optimum or above
LVC Soils	18 inches placed in 3 lifts, compacted to 95% MDD within 2% of OM
Aggregate Base	4" compacted to 95% MDD within 2% of optimum moisture

5.7 Shallow Footing Foundations

Shallow footing foundations can be used to support the proposed buildings. To provide adequate confinement and prevention of shrinking or swelling of the subgrade soils due to moisture change, footings should bear at a depth of at least 2 feet below the final adjacent subgrade elevation. For the design of footings bearing within undisturbed, native soils or tested and approved fill at the recommended depth, a maximum net allowable bearing pressure of 2,000 pounds per square foot can be used for foundation design. This is the pressure at the base of the footing in excess of the adjacent overburden pressure. A representative of the geotechnical engineer should be retained to evaluate that footings bear on soils suitable for the design pressure prior the placement of concrete.

Continuous formed footings should have a minimum width of at least 16 inches, and isolated column footings should have a minimum width of at least 30 inches. Earth formed trench footings also could be used and should have a minimum width of at least 12 inches.

Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry material, or any loose or disturbed material in the bottom of the footing excavations, should be removed prior to placing concrete.

Long-term movement is expected to be less than 1-inch for footings bearing within the materials described above and proportioned for the recommended maximum net allowable bearing pressure.

Differential footing movement is not expected to exceed approximately 1/2 of this value.

5.8 Pavement Thickness & Subgrade Development

Light-duty parking lot pavements are expected to support passenger automobiles only. Drive and parking areas accessible to buses, delivery trucks or refuse collection trucks should be designed as heavy-duty pavements. Based on laboratory testing of the subgrade soils, a CBR value of 2 should be used for the design of pavements at this site. The following table provides minimum pavement thicknesses for both rigid and flexible pavements.

	Light Duty Pavement	**Heavy Duty Pavement**
Rigid Pavement	5” Portland Cement Concrete (3500 psi min.) 6” ODOT Type “A” Aggregate Base or 8” Stabilized Subgrade	7” Portland Cement Concrete (3500 psi min. doweled) 6” ODOT Type “A” Aggregate Base or 8” Stabilized Subgrade
Flexible Pavement	2” Type S4 ACC (PG 64-22 OK) 3” Type S3 ACC (PG 64-22 OK) 6” ODOT Type “A” Aggregate Base or 8” Stabilized Subgrade	2” Type S4 ACC (PG 64-22 OK) 2” Type S4 ACC (PG 64-22 OK) 3” Type S3 ACC (PG 64-22 OK) 6” ODOT Type “A” Aggregate Base or 8” Stabilized Subgrade

It is recommended that reinforced concrete pads be constructed in front of and beneath the refuse storage and pick-up area. The dumpster trucks should be parked on rigid Portland cement concrete pavement when the trash receptacles are lifted. The concrete pad should be at least 7 inches thick and fully reinforced.

Before fill is placed, the subgrade should be proof-rolled as recommended in Section 5.4 of this report. Once design grades are developed, 6 inches of ODOT Type “A” Aggregate Base should be placed for direct pavement support. Aggregate base materials should be compacted to at least 98 percent of the materials maximum dry density per test method ASTM D 698 at a moisture content within 2 percent of optimum. A separator fabric or geogrid could be placed between the aggregate base and the subgrade soils to provide long-term separation of the materials.

As an alternative to aggregate base, the top 8 inches of the subgrade could be stabilized with an estimated 5 percent hydrated lime. The actual percentage of additive should be determined at the time of construction for the exposed subgrade soils. After final mixing of the additive and adjusting the moisture content of the mixture to within two percent of optimum, the material should be compacted to at least 98 percent of the materials maximum dry density as determined by test method ASTM D-698.

All fill required to develop final grade lines in the proposed parking and drive areas should consist of low volume change soils that are free of organic matter and debris. Fill should be placed in lifts not exceeding 6 inches and should be compacted to at least 95 percent of the maximum dry density at a moisture content within 2 percent of optimum. Any soft or loose areas observed or over-saturated, rutting or pumping soils observed during compaction operations should be removed and replaced.

During compaction operations, each lift of compacted fill should be tested for moisture and density and reworked as necessary until that surface is approved by the geotechnical engineer's representative prior to the placement of additional lifts. We recommend the aggregate base or stabilized subgrade, and each lift of fill be tested for density and moisture content at a rate of one test per 10,000 square feet of compacted area with a minimum of two tests per compacted area. In addition, we recommend one test per lift for every 100 linear feet of compacted utility trench backfill. The moisture content of the aggregate base or stabilized soil should be maintained near optimum during construction. We recommend the moisture content be evaluated immediately before pavement is placed.

Minimizing subgrade saturation is an important factor in maintaining subgrade strength. Water allowed to pond on or adjacent to pavements could saturate the subgrade and cause premature pavement deterioration. The pavement and subgrade should be sloped approximately ¼ inch per foot to provide rapid surface drainage, and positive surface drainage should be maintained away from the edge of the paved areas. Design alternatives that would reduce the risk of subgrade saturation and improve long-term pavement performance include placing a separator fabric between the aggregate base and subgrade soils, crowning the pavement subgrade to drain toward the edges, rather than to the center of the pavement areas and installing surface drains next to any areas where surface water could pond.

Maintenance of the pavement will be required to obtain a satisfactory design life. Maintenance should include crack sealing, surface sealing and patching of any deteriorated areas. In addition, thicker pavement sections could be used to reduce the required maintenance and extend the service life of the pavement.

6.0 CONCLUDING REMARKS

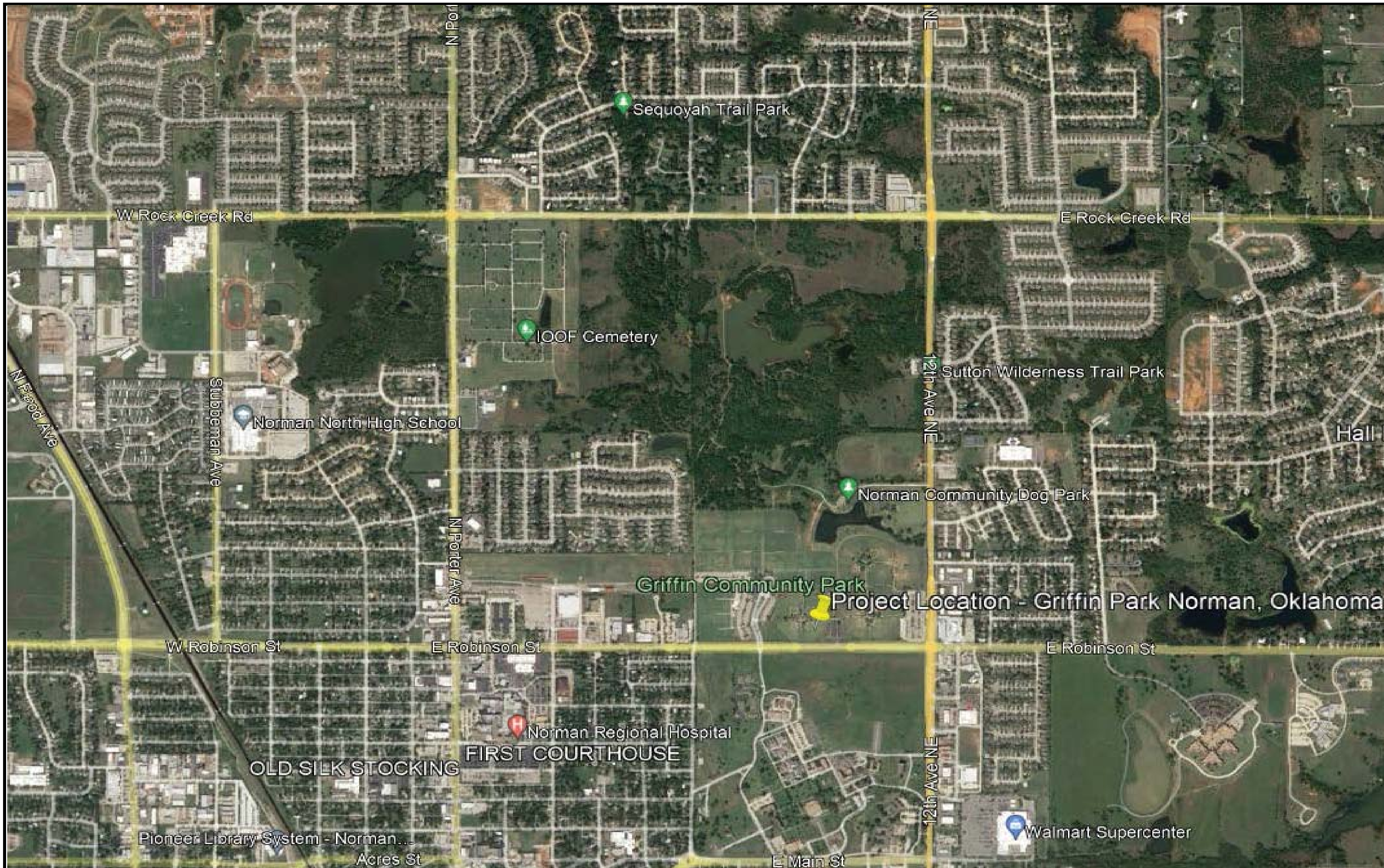
Recommendations provided in this report are based on information from discrete borings (generally 4 to 8 inches in diameter) and, in some cases, from an engineer's general surficial observations. All site conditions cannot be detailed based on a limited number of borings and increasing the number of borings so that all site conditions can be defined is generally not practical. Variations in site conditions between boring locations should be expected and, on occasion, revised recommendations will be required. Hinderliter Geotechnical Engineering, LLC (HGE) should be retained to review final plans and specifications so that comments can be provided regarding the implementation of recommendations provided in this report. HGE should also be retained by the project owner or design engineer to provide monitoring of site construction.

This report provides recommendations concerning site construction and, while it may provide limited analysis of soil corrosiveness and / or contaminant content, is not an Environmental Site Assessment (ESA). If the Owner is concerned about environmental and / or biological assessment, a separate study specifically focused on environmental issues should be undertaken.

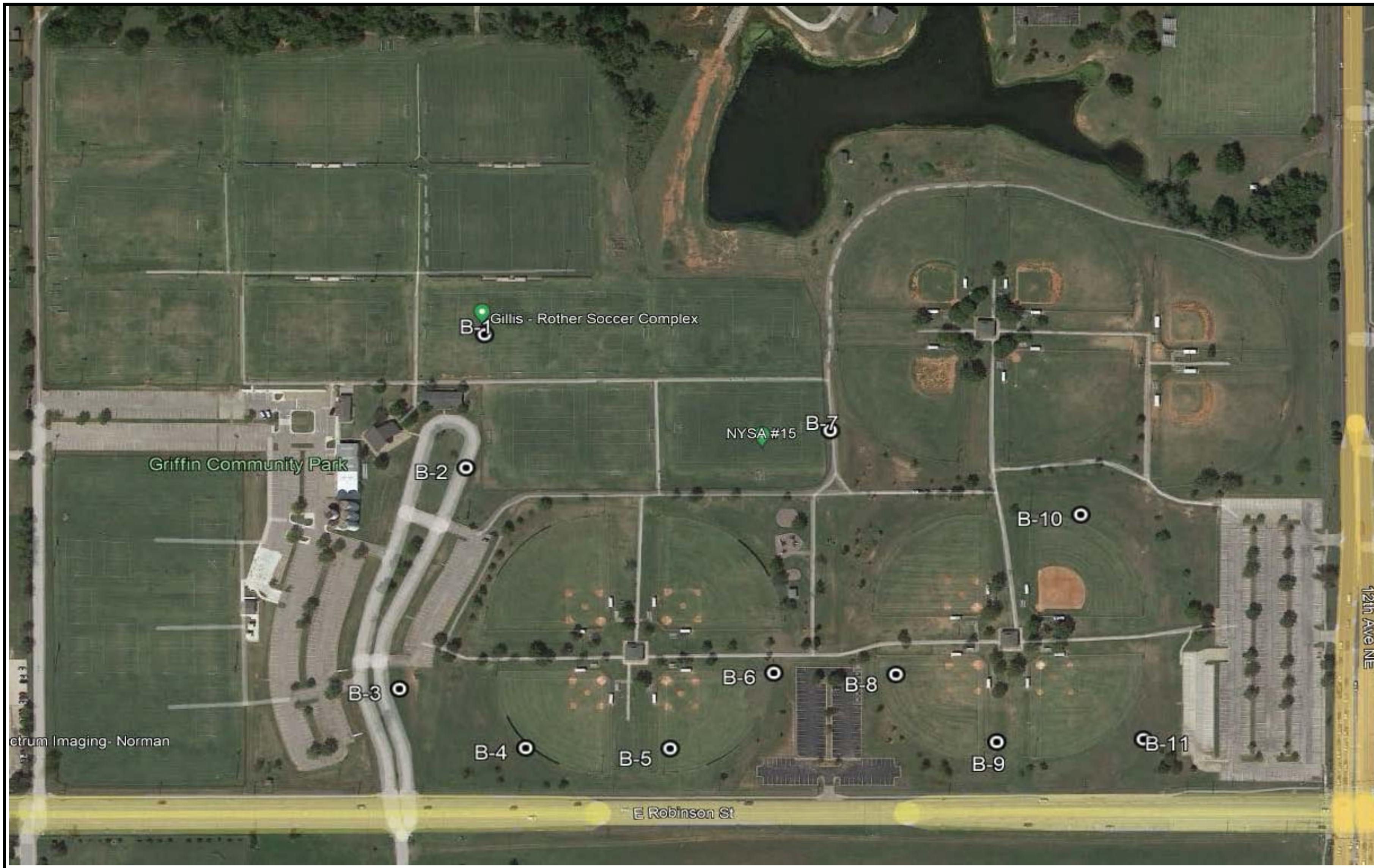
This report has been prepared specifically for the referenced project and for the exclusive use of our Client. Third-party reliance may be granted upon specific written request of the Client. This report has been prepared using locally specific and generally accepted geotechnical engineering practices based on structural information provided by the Client and information gained from the site. No warranties are implied or granted regarding site recommendations not specifically discussed in this report.

APPENDIX A

SITE VICINITY MAP
BORING LOCATION DIAGRAM
BORING LOGS



SITE VICINITY MAP	HINDERLITER GEOTECHNICAL ENGINEERING	GRIFFIN PARK E ROBINSON ST & 12TH AVE NE NORMAN, OKLAHOMA	ENGINEER MHH DRAWN BY MHH REVISIONS	SCALE NOT TO SCALE PROJECT NO. CEC-22-09 DATE JUNE 2022



APPROXIMATE BORING LOCATIONS	HINDERLITER GEOTECHNICAL ENGINEERING	GRIFFIN PARK E ROBINSON ST & 12TH AVE NE NORMAN, OKLAHOMA	ENGINEER MHH	SCALE NOT TO SCALE
			DRAWN BY MHH	PROJECT NO. CEC-22-09
			REVISIONS	DATE JUNE 2022

LOG OF BORING B-01

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
Groundwater encountered at approximately 7 feet while drilling and measured at 12 feet after boring completion.

SURFACE ELEVATION: 102.9

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–3	N = 7	16.6									Light Vegetation Cover SILTY CLAY (CL-ML) light brown medium stiff
3–6	N = 16	19.9	30	13	17		100	100	100	92.8	LEAN CLAY (CL) brown stiff to very stiff
6–10	N = 50/6	20.6									WEATHERED SANDSTONE red soft poorly cemented
	N = 50/5	17.4									
10–15	N = 80	16.5									LEAN CLAY (CL) red very hard
15											Bottom of boring 15 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.235770
Longitude -97.429390

LOG OF BORING B-02

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 102.9

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Light Vegetation Cover
	1												LEAN CLAY (CL) brown medium stiff to stiff
	2	X	N = 7	20.2	34	12	22		100	100	98	90.3	
	3												
	4	X	N = 12	19.2									
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.234891
Longitude -97.429319

LOG OF BORING B-03

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 100.2

	FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Light Vegetation Cover
	1												LEAN CLAY (CL) dark brown, reddish brown stiff
	2		N = 10	19.3									
	3												
	4		N = 10	20.5	38	16	22		100	100	99	91.4	
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233682
Longitude -97.429824

LOG OF BORING B-04

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 102.0

	FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Light Vegetation Cover
	1												LEAN CLAY (CL) brown, red very stiff
	2		N = 16	15.8	36	17	19		100	100	99	88.1	
	3												
	4		N = 22	13.3									
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233281
Longitude -97.428978

LOG OF BORING B-05

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 106.0

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Light Vegetation Cover
	1												LEAN CLAY (CL) brown medium stiff to very stiff
	2		N = 7	22.4									
	3												
	4		N = 17	15.8	49	14	35		100	100	98	90.8	
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233262
Longitude -97.428041

LOG OF BORING B-06

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 106.3

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Light Vegetation Cover
	1–2.5	X	N = 15	20.3	43	14	29		100	100	97	90.2	LEAN CLAY (CL) reddish brown stiff to very stiff
	3.5–5	X	N = 23	17.0									
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233760
Longitude -97.427342

LOG OF BORING B-07

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 103.0

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0–1												Light Vegetation Cover
	1–3	X	N = 7	21.9	38	16	22		100	100	99	87.5	LEAN CLAY (CL) red medium stiff to very stiff
	3.5–5	X	N = 13	16.2									
	6–7.5	X	N = 24	15.4									
	8.5–10	X	N = 59	12.7									SHALEY LEAN CLAY (CL) red hard with very hard seams
	13.5–14.5	X	N = 50/2	11.5									
	15												Bottom of boring 15 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.235070
Longitude -97.426980

LOG OF BORING B-08

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 107.2

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Dozer Cleared
	1												SANDY SILT (ML) red very hard
	2		N = 79	10.9	NP	NP	NP		100	100	100	62.2	
	3												
	4		N = 66	15.5									
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233785
Longitude -97.426647

LOG OF BORING B-09

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 107.4

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Light Vegetation Cover LEAN CLAY (CL) brown, red very stiff
	1												
	2	X	N = 17	19.0									
	3												
	4	X	N = 18	18.7	34	15	19		100	100	99	96.0	
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233210
Longitude -97.425928

LOG OF BORING B-10

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 109.0

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–5											Dozer Cleared LEAN CLAY (CL) brown stiff
1.5	N = 8	20.5									
4	N = 11	20.2	33	16	17		100	100	99	88.4	
5–11											LEAN CLAY (CL) red stiff to very stiff
6.5	N = 10	18.1									
9	N = 23	11.7									
11–14.5											SHALEY LEAN CLAY (CL) red very stiff to hard with very hard seams
14	N = 50/3	10.8									
											Bottom of boring 15 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.234650
Longitude -97.425446

LOG OF BORING B-11

Hinderliter Geotechnical Engineering
4071 NW 3rd Street
Oklahoma City, OK 73107
Telephone: (405) 942-4090
Website: HinderliterGeo.com

CLIENT: CEC Corporation
PROJECT: Griffen Park Improvements
LOCATION: Norman, Oklahoma
NUMBER: CEC-22-09

DATE(S) DRILLED: 5/9/22

DRILLING METHOD(S):
6" solid flight augers. SPT penetration testing & sampling.

GROUNDWATER INFORMATION:
No groundwater encountered prior to boring termination.

SURFACE ELEVATION: 108.8

FIELD DATA / LABORATORY DATA

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	MINUS NO. 4 SIEVE (%)	MINUS NO. 10 SIEVE (%)	MINUS NO. 40 SIEVE (%)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													Dozer Cleared
	1												LEAN CLAY (CL)
			N = 10	15.5	31	15	16		100	100	99	86.1	red stiff to hard
	2												
	3												
	4												
			N = 37	10.2									
	5												Bottom of boring 5 feet

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Approximate Boring Location:
Latitude 35.233247
Longitude -97.424836

APPENDIX B

LABORATORY SUMMARY
COMPACTION TEST REPORT
BEARING RATIO TEST REPORT

CEC®

13801 N. Meridian Ave.
Oklahoma City, OK 73134
Phone:(405) 753-6840

Laboratory Summary

Report Date: 05/30/2022 **Date Sampled:** 05/10/2022
Project: 12130.86 **Sampled By:** HGE
Norman Griffin Park-Geotech

Location: See Attached Boring Locations

Client: City of Norman
Contractor: Crossland Construction **Lab No:** OKC#1979-22

TEST RESULTS **Report No:** 0001

Boring No.	Depth	Soil Description	Soil Group	Moisture (%)	Liquid Limit	Plastic Index	Percent Passing -10 Sieve	Percent Passing - 40 Sieve	Percent Passing - 100 Sieve	Percent Passing - 200 Sieve	Soluble Sulfates (PPM)
B-1 S-1	1-2.5'	Light Brown Lean Clayw/Silt		16.6							
B-1 S-2	3.5-5'	Brown Lean Clay	A-6(14)	19.9	30	17	100	99.8	99	92.8	
B-1 S-3	6-7.5'	Red Sitly Clay		20.6							
B-1 S-4	8.5-10.0'	Red Sandy Silt		17.4							
B-1 S-5	13.5-15.0	Red Lean Clay		16.5							
B-2 S-1	1-2.5'	Brown Lean Clay	A-6(18)	20.2	34	22	100	97.6	95.8	90.3	
B-2 S-2	3.5-5'	Brown Clay		19.2							
B-3 S-1	1-2.5'	Dark Brown Lean Clay		19.3							
B-3 S-2	3.5-5'	Reddish Brown Lean Clay	A-6(20)	20.5	38	22	100	98.6	96.9	91.4	
B-4 S-1	1-2.5'	Brown Lean Clay	A-6(16)	15.8	36	19	100	98.7	96.9	88.1	
B-4 S-2	3.5-5'	Red Clay		13.3							
B-5 S-1	1-2.5'	Brown Clay		22.4							
B-5 S-2	3.5-5'	Brown Lean Clay	A-7-6(33)	15.8	49	35	100	97.9	95.9	90.8	
B-6 S-1	1-2.5'	Reddish Brown Lean Clay	A-7-6(26)	20.3	43	29	100	96.7	94.7	90.2	
B-6 S-2	3.5-5'	Orange Lean Clay		17.0							

1-ec Crossland Construction Attn: Blake Madden
1-ec NYSA Attn: Steve Gillis
1-ec City of Norman Attn: Wade Thompson
1-ec PDG - Planning Design Group Attn: Geoff Evans

Respectfully Submitted,
CEC Materials Testing

LICENSED PROFESSIONAL ENGINEER
ELISABETH RYON
32236
OKLAHOMA

Elisabeth Ryon, Department Head

05/31/2022

CEC®

13801 N. Meridian Ave.
Oklahoma City, OK 73134
Phone:(405) 753-6840

Laboratory Summary

Report Date: 05/30/2022 **Date Sampled:** 05/10/2022
Project: 12130.86 **Sampled By:** HGE
Norman Griffin Park-Geotech

Location: See Attached Boring Locations

Client: City of Norman
Contractor: Crossland Construction **Lab No:** OKC#1979-22

TEST RESULTS **Report No:** 0001

Boring No.	Depth	Soil Description	Soil Group	Moisture (%)	Liquid Limit	Plastic Index	Percent Passing -10 Sieve	Percent Passing - 40 Sieve	Percent Passing - 100 Sieve	Percent Passing - 200 Sieve	Soluble Sulfates (PPM)
B-7 S-1	1-2.5'	Red Lean Clay	A-6(19)	21.9	38	22	100	98.7	97	87.5	
B-7 S-2	3.5-5'	Red Silty Lean Clay		16.2							
B-7 S-3	6-7.5'	Red Lean CLay		15.4							
B-7 S-4	8.5-10.0'	Red Clay		12.7							
B-7 S-5	13.5-15.0'	Red Silty Lean Clay		11.5							
B-8 S-1	1-2.5'	Red Sandy Silt	A-4(0)	10.9	NV	NP	100	99.5	99.2	62.2	
B-8 S-2	3.5-5'	Red Silty Sand		15.5							
B-9 S-1	1-2.5'	Brown Clay		19							
B-9 S-2	3.5-5'	Red Lean Clay	A-6(18)	18.7	34	19	100	99.1	98.4	96.0	
B-10 S-1	1-2.5'	Brown Clay		20.5							
B-10 S-2	3.5-5'	Brown Lean Clay	A-6(14)	20.2	33	17	100	98.7	96.5	88.4	
B-10 S-3	6-7.5'	Red Lean Clay w/Silt		18.1							
B-10 S-4	8.5-10.0'	Red Lean Clay		11.7							
B-10 S-5	13.5-15.0'	Red Sandy Silt		10.8							
B-11 S-1	1-2.5'	Red Lean Clay	A-6(12)	15.5	31	16	100	98.9	97.9	86.1	
B-11 S-2	3.5-5'	Red Silty Lean Clay		10.2							
BCS-1	Various	Brown Lean Clay	A-6(21)		38	24	100	98.8	96.1	89.6	<200

Remarks: HGE Report No. CEC-22-09
Test Methods: AASHTO T11, T88, T89, T90, T99, T255

1-ec Crossland Construction Attn: Blake Madden
1-ec NYSA Attn: Steve Gillis
1-ec City of Norman Attn: Wade Thompson
1-ec PDG - Planning Design Group Attn: Geoff Evans

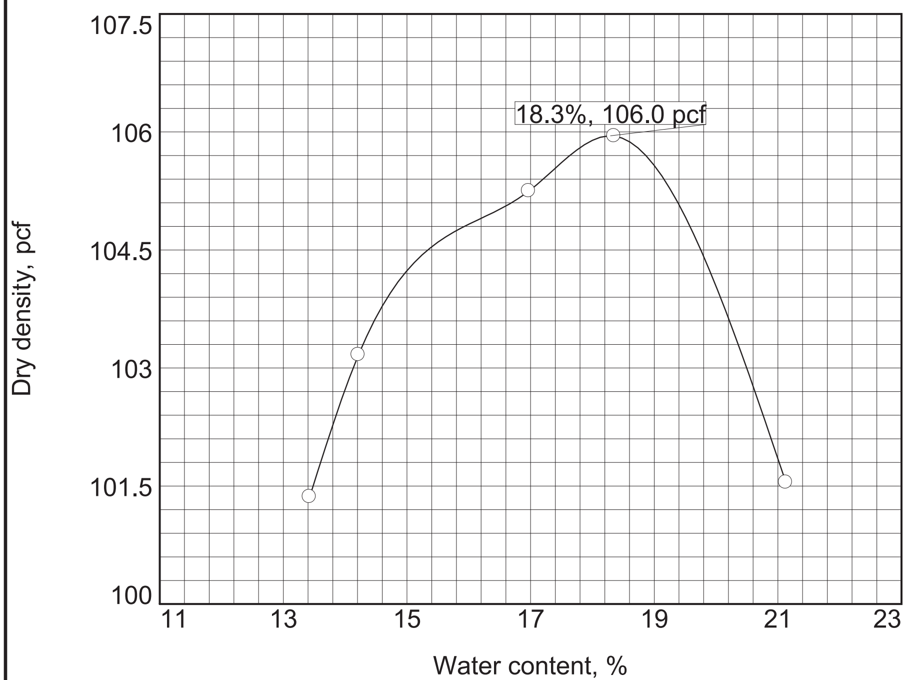
Respectfully Submitted,
CEC Materials Testing

LICENSED PROFESSIONAL ENGINEER
ELISABETH RYON
32236
OKLAHOMA

Elisabeth Ryon, Department Head

05/31/2022

COMPACTION TEST REPORT



Preparation Method	Dry
Rammer: Wt.	5.5 lb.
Drop	12 in.
Type	Manual
Layers: No.	Three
Blows per	25
Mold Size	0.03333 cu. ft.
Test Performed on Material Passing	#4 Sieve
%>#4	0.0
%<No.200	89.6
Atterberg (D 4318): LL	38
PI	24
NM (D 2216)	
Sp.G. (D 854)	
USCS (D 2487)	CL
AASHTO (M 145)	A-6(21)
Date: Sampled	5/10/22
Received	5/10/22
Tested	5/12/22
Tested By	A. Taylor

COMPACTION TESTING DATA
AASHTO T 99-15 Method A Standard

	1	2	3	4	5	6
WM + WS	5991.6	6034.8	6114.6	6149.1	6113.0	
WM	4253.4	4253.4	4253.4	4253.4	4253.4	
WW + T #1	176.0	169.7	158.4	152.4	146.4	
WD + T #1	158.8	152.5	139.8	133.7	126.2	
TARE #1	30.7	31.5	30.2	31.8	30.6	
WW + T #2						
WD + T #2						
TARE #2						
MOIST.	13.4	14.2	17.0	18.4	21.1	
DRY DENS.	101.4	103.2	105.2	105.9	101.5	

SIEVE TEST RESULTS
AASHTO T 27 AASHTO T 11

Opening Size	% Passing	Specs.
#10	100.0	
#40	98.8	
#100	96.1	
#200	89.6	

TEST RESULTS

Maximum dry density = 106.0 pcf

Optimum moisture = 18.3 %

Material Description

Brown Lean Clay

Remarks:
Sulfate PPM=<200

Project No. CEC-22-09 **Client:** City Of Norman
Project: Griffin Park

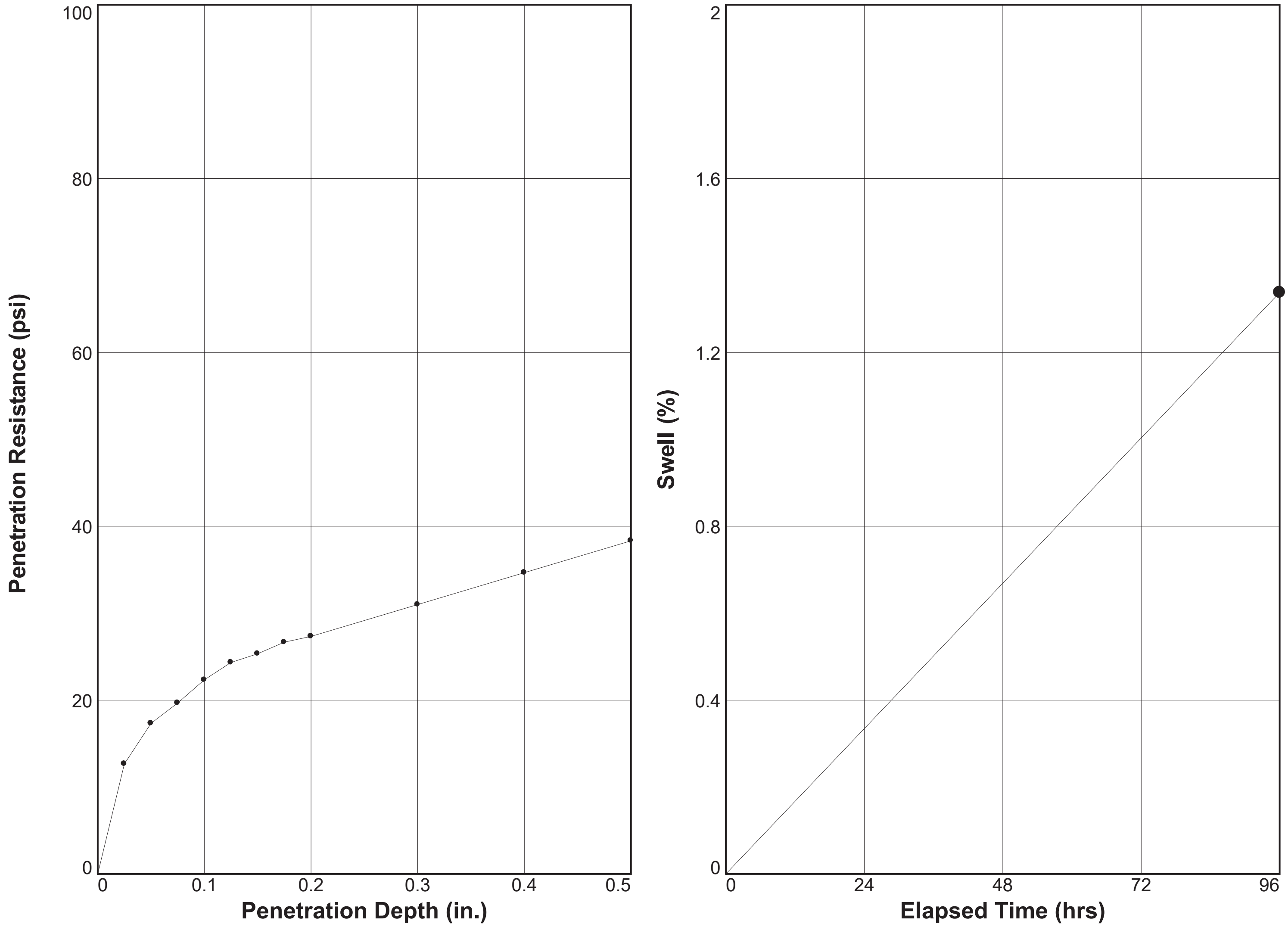
○ **Sample Number:** BCS-1

CEC materials testing

Checked by: R. Saldana
Title: Soils Lab Coordinator

Figure

BEARING RATIO TEST REPORT
AASHTO T 193-13



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	101.2	95.5	20.3	99.9	94.2	21.3	2.2	1.8	0.000	10	1.3
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Brown Lean Clay	CL	106.0	18.3	38	24

Project No: CEC-22-09

Project: Griffin Park

Sample Number: BCS-1

Date: 5/10/22

CEC materials testing

Test Description/Remarks:

Figure ________

APPENDIX C

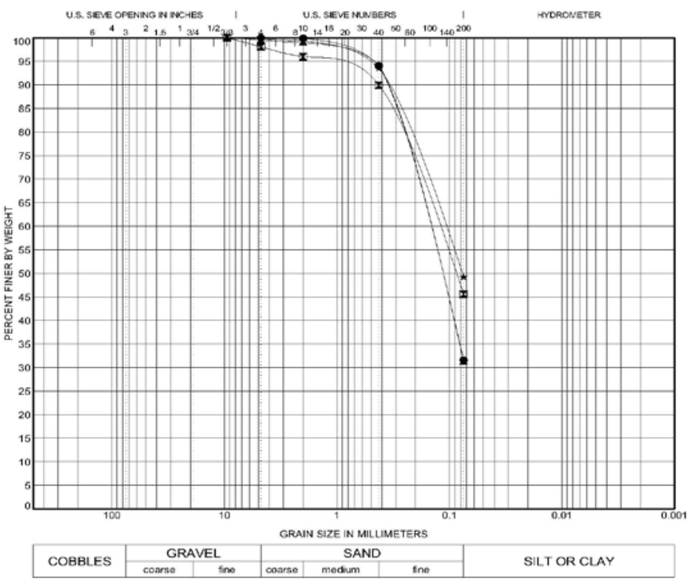
GENERAL NOTES ON SOIL CLASSIFICATION
GENERAL NOTES ON ROCK CLASSIFICATION

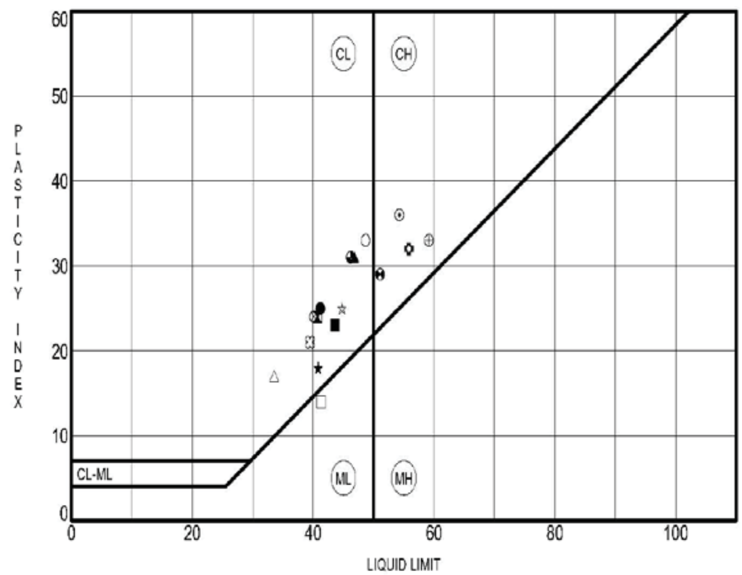
HINDERLITER GEOTECHNICAL ENGINEERING

GENERAL NOTES ON SOIL CLASSIFICATION

Hinderliter Geotechnical Engineering classifies soils in accordance with the Unified Soil Classification System (USCS). In some cases, the AASHTO Classification System is also used.

USCS soil classifications are derived from soil grain size and material plasticity. Materials with more than 50 percent passing the No. 200 U.S. Sieve (aperture opening = 0.075 mm) are considered to be fine-grained soils (silts or clays). Materials with less than 50 percent passing the No. 200 sieve are considered to be coarse-grained soils (sands, gravels, etc). Coarse-grained soils are classified by the USCS System by plotting the Grain Size in Millimeters vs. Percent Finer by Weight. Depending on the grain size, the materials are classified as cobbles, gravel, sand, or silt / clay. Material plasticity is determined from the Liquid Limit test and the Plastic Limit test. The Liquid Limit (LL) of a soil is the point where, when mixed with water, a pat of soil transitions from a liquid state to a plastic state. The Plastic Limit (PL) is the point where the soil transitions from a plastic state to a solid state. The difference between the LL and PL is known as the Plasticity Index (PI).





Most naturally-occuring materials have some portion of fine-grained and coarse-grained materials. Modifiers are used to describe the relative percentage of minor-occurring materials in the following fashion:

Fine-Grained Soil Modifiers			Coarse-Grained Soil Modifiers	
Modifier	Percentage of Dry Weight		Modifier	Percentage of Dry Weight
Trace	< 15		Trace	< 5
With	15 - 29		With	5-12
Sandy, Gravelly, etc.	> 30		Silty, Clayey, etc.	> 12

The consistency of fine-grained soils and the relative density of coarse-grained soils is generally included on the boring logs as part of the material description. Consistency and relative density are generally defined as follows:

Fine-Grained Soils			Coarse-Grained Soils	
Unconfined Compressive Strength, Qu, psf	Consistency	Standard Penetration Test, N, blows / foot	Standard Penetration Test, N, blows / foot	Relative Density
< 500	Very Soft	< 2	0 - 3	Very Loose
500 - 1000	Soft	2 - 4	4 - 9	Loose
1000 - 2000	Medium	5 - 7	10 - 29	Medium Dense
2000 - 4000	Stiff	8 - 15	30 - 49	Dense
4000 - 8000	Very Stiff	16 - 30	50+	Very Dense
8000+	Hard	30+		

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General Notes on Soil Classification

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GENERAL NOTES ON ROCK CLASSIFICATION

Sedimentary Rock Classification

Sedimentary rock is classified based on material composition, weathering and hardness. Depending on how samples are obtained, a measure of the degree of jointing can also be determined. Sedimentary rock is composed of clay, silt and/or sand sized particles and is often named based on the soil classification of the deposited material, such as sandstone or siltstone. Limestone, chert and shale are also sedimentary rock types.

Shale

In general, the reddish shales of western and central Oklahoma or Texas tend to be highly weathered and soft. They are composed of cemented clays but frequently contain lesser amounts of silt, sand or caliche. In eastern Oklahoma, Texas and Missouri the shales tend to be dark in color, usually gray, less weathered and harder.

Sandstone

Reddish sandstones in western and central Oklahoma and Texas tend to be highly weathered and soft. These sandstones often have relatively high clay or silt contents. Sandstones in eastern Oklahoma, Texas and Missouri tend to be brownish and hard. Sandstones may be described according to degree of cementation; well-cemented, cemented or poorly-cemented.

Limestone

Generally light colored and hard, limestone reacts readily with hydrochloric acid due to its calcium carbonate content.

Sedimentary rock can be evaluated by sampling and testing or by in-situ evaluation methods. Frequently, soft sedimentary rock is evaluated using penetration testing methods such as the split-barrel (SPT) method or through use of a Texas Cone (TC). Hard rock is often cored and evaluated by cutting or scratching, or by unconfined compressive strength measurements. In-situ methods, such as the Pressuremeter, can also be used.

SPT "N" Values (50 blows / 6" or less)	Hardness	Texas Cone "T" Values (100 blows / 6" or less)
50/6", 50/5"	Soft	100/3" or more
50/4", 50/3"	Moderately Hard	100/2", 100/1"
50/2" or less	Hard, often cored	100/1" or less

Sedimentary rock is generally cored in 5-foot or 10-foot increments or runs. Rock Core Recovery (R) is measured and expressed as a percentage of the total run. The Rock Quality Designation (RQD), defined as in-tact pieces of core 4 inches or more in length, is also measured and expressed as a percentage of the total core run.

RQD (%)	Empirical Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
Below 25	Very Poor

Rock Core Hardness:

Soft - Can be broken by hand or carved with a knife.
Moderately Hard - Can be scratched with a penny.
Hard - Can be scratched with a knife.
Very Hard - Cannot be scratched with a knife.

Layering or Bedding:

Fissile - Splits along closely spaced planes 1/16" or less.
Thin Bedded - Beds 2 inches to 2 feet.
Thick Bedded - Beds 2 feet to 4 feet.
Massive - Beds greater than 4 feet.

Joints, Faults or Fractures:

Very Low Jointing - More than 6-1/2 feet between discontinuities.
Low Jointing - 2 feet to 6-1/2 feet.
Medium Jointing - 8 inches to 2 feet.
High Jointing - 2-1/2 inches to 8 inches.
Very High Jointing - Less than 2-1/2 inches.

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